

Claims

- [c1] 1.A micro-heating apparatus for locally controlling a temperature in a mold, the micro-heating apparatus comprising:
- a substrate;
 - at least a micro-heating module installed on the substrate, the micro-heating module comprising:
 - a micro-heater;
 - an external power circuit; and
 - a connection electrode for connecting the external power circuit and a programmable external power device; and
 - at least a temperature detector installed on the substrate near the micro-heater for measuring the local temperature;
- wherein the substrate with the micro-heating module and the temperature detector is capable of combining with the mold so that the micro-heater directly or indirectly contacts a plastic material in the mold, and the programmable external power device including a power supply and a temperature controller is used for connecting to the external power circuit to control the micro-heater to heat the plastic material so as to control the temperature when the temperature around an interface

of the plastic material and the micro-heater is measured.

- [c2] 2.The micro-heating apparatus of claim 1, wherein the micro-heater and the temperature detector have a micro-single layer structure or a micro-multi layer structure with a plurality of serial or parallel geometry shapes fabricated by a thin film process such as a micro-electromechanical system process, a thick film process such as a screen printing process, or a low-temperature co-fired ceramics (LTCC) process.
- [c3] 3.The micro-heating apparatus of claim 1, wherein the micro-heating apparatus is set in an injection mold, an injection compression mold, a hot embossing mold, or other devices in need of controlling a local temperature.
- [c4] 4.The micro-heating apparatus of claim 1, wherein the micro-heater indirectly contacts the plastic material in the mold means that the mold further comprises a stamper with a plurality of microstructures set on the substrate, so that the micro-heater is capable of heating the plastic material through the stamper.
- [c5] 5.A method of fabricating a plastic chip having a plurality of microstructures with a fine size and a high aspect ratio, the method comprising:
installing the micro-heating apparatus of claim 1 in the

mold;

performing an injection compression process for gaining a better transfer ratio during the compressing process;

and

using the micro-heating apparatus to control the temperature in an cooperation with an injection process.

[c6] 6.The method of claim 5, wherein the cooperation comprises:

before filling the plastic material, measuring the temperature around the interface of the plastic material and the micro-heater where the plastic material easily solidifies;

using the programmable external power device to control the micro-heater to preheat the interface so as to raise the local temperature, so that the plastic material easily flows through the injection mold when the plastic material is filled and compressed;

using the micro-heater to locally anneal the plastic material at the microstructures with a high aspect ratio after filling the plastic material so as to prevent the plastic material from becoming deformed resulting from a residual stress; and

adjusting a power by the micro-heater module and controlling a feedback of the temperature detector to generate a specific temperature gradient so that the plastic material has a best temperature during a cooling process

to prevent a product from becoming deformed.